Agent-based Integrated Analysis Framework

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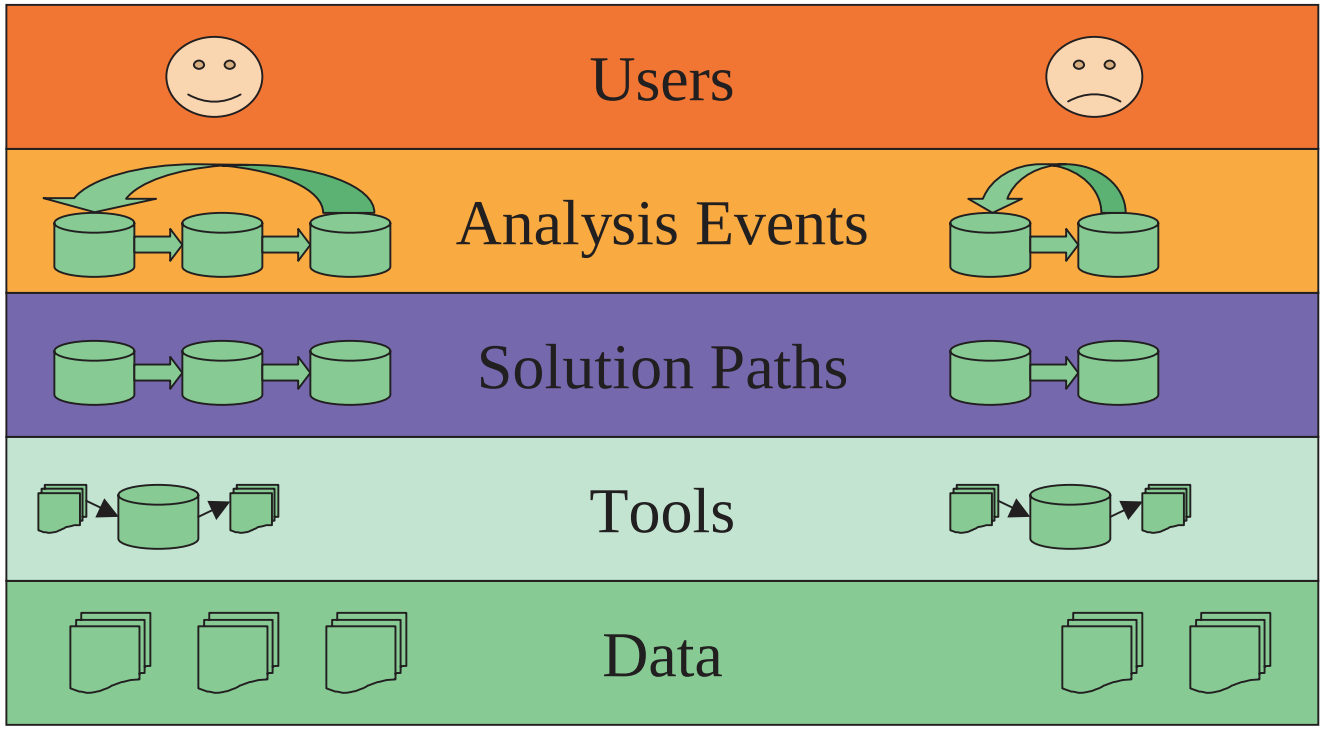
Overview

- Goals
- Framework Layers
- Type of Analysis
- Tool Integration Methods
- Agent-based Capabilities
- Framework Infrastructure
- Future Work

Goals

- Develop prototype framework to test concepts
- Demonstrate integration of high-fidelity analysis tools
- Demonstrate utility of agents and agent-based software

Framework Layers

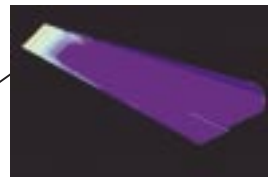


Type of Analysis

CAD

CFD

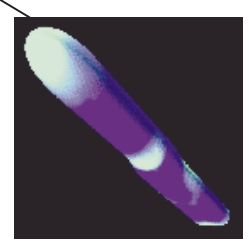
FEM



Pro/ Engineer

UPS

ANSYS



GASP

TIGER

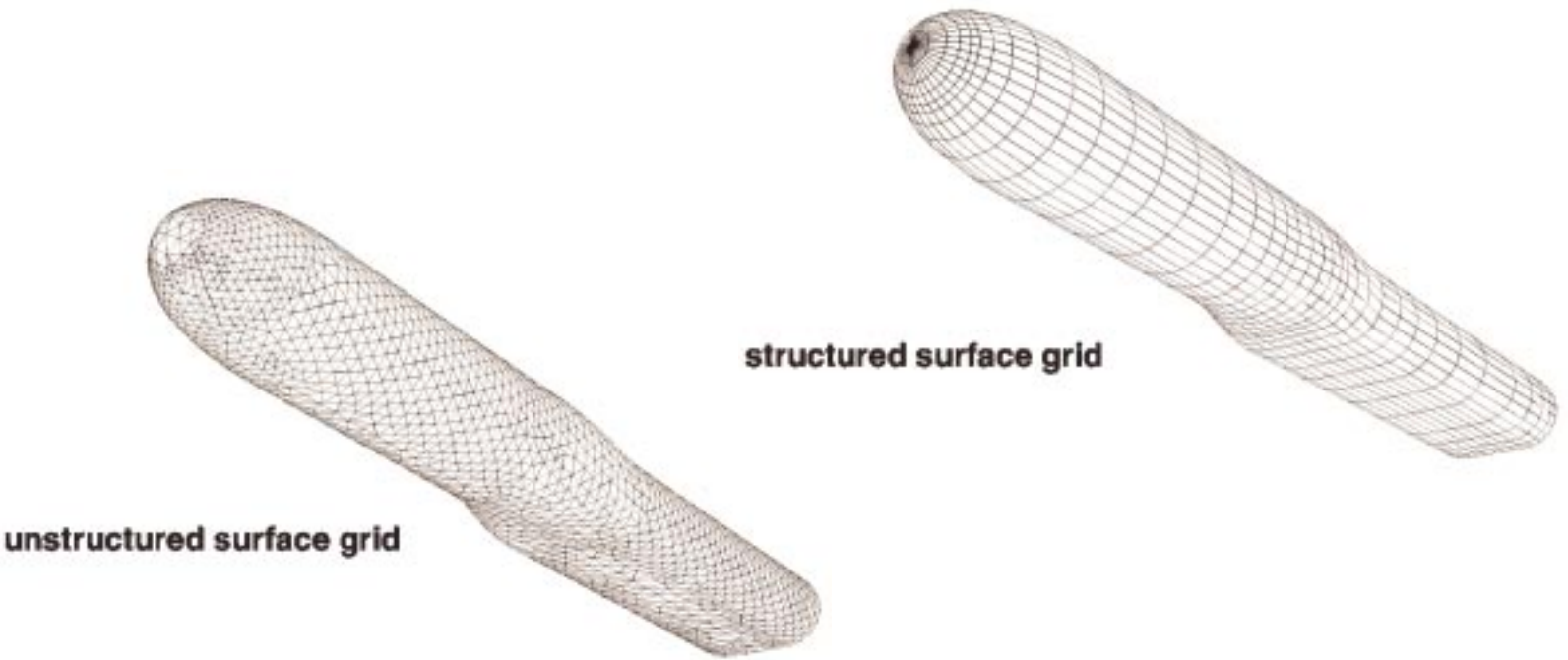
Tool Integration Methods

- Goal is problem independence
- Data Transfer between Unstructured and Structured Grids
  - Surface Grid Generator
  - Data Interpolation Tools
    - CFD to FEM
    - FEM to CFD

Surface Grid Generator

- Semi-automatically build structured surface grid from unstructured surface grid
- Tested on simple geometries (i.e., SHARP, ASTP fuselage)

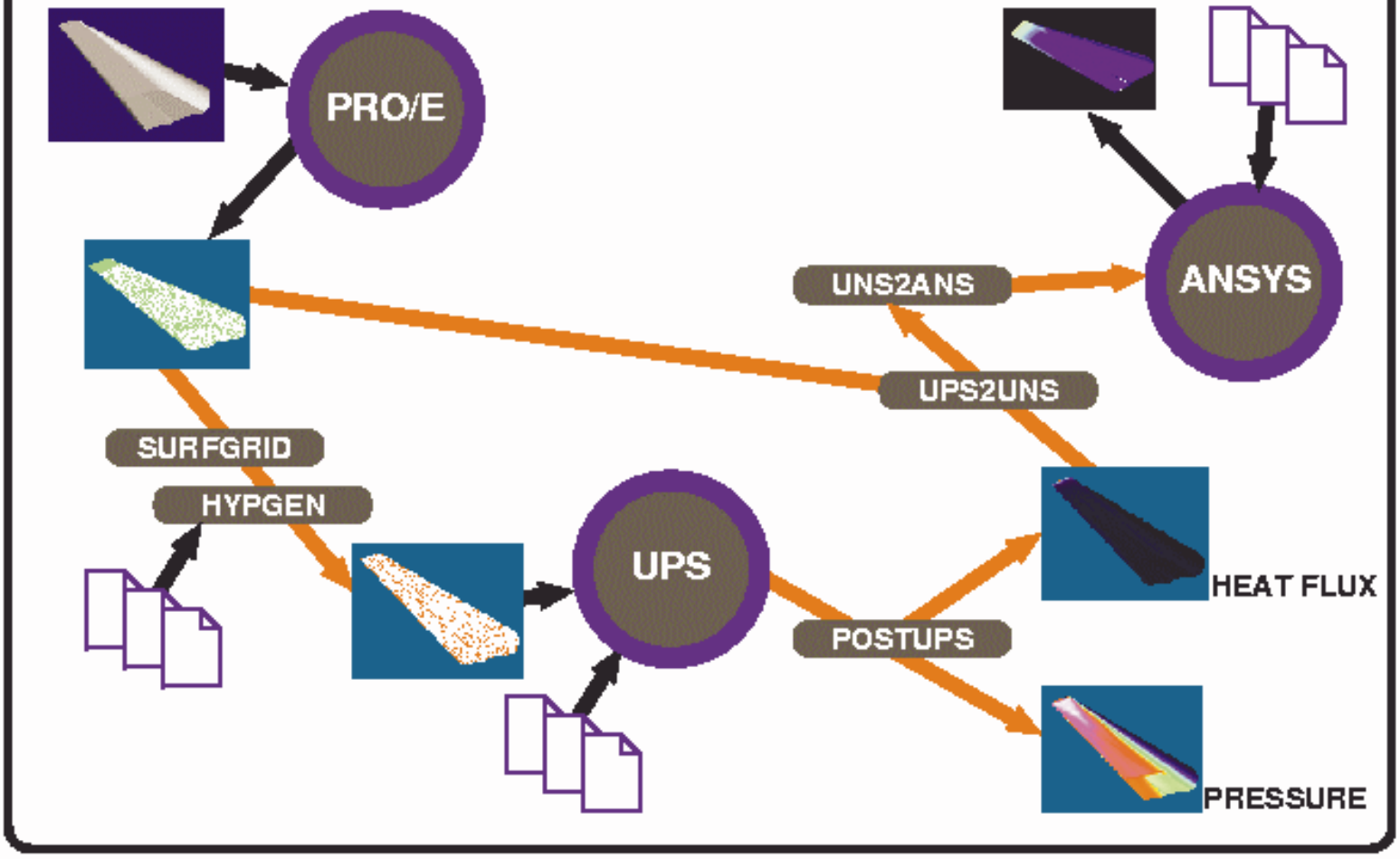
Surface Grid Example



Data Interpolation Tools

- Use triangulated surfaces
- Find donor triangle using binary tree search
  - Fast search
  - Test for containment of point in triangle
- Linear interpolation using data at vertices
- Analysis tool dependent due to input/output format requirements

PROTOTYPE AGENT SOLUTION FOR SHARP



Agents in the Framework

- An agent acts upon its view of the world
  - Perceives its environment
  - Makes decisions based on perceptions
- Try to remove these user constraints
  - “I didn’t know the tool existed”
  - “I don’t know how to use it”

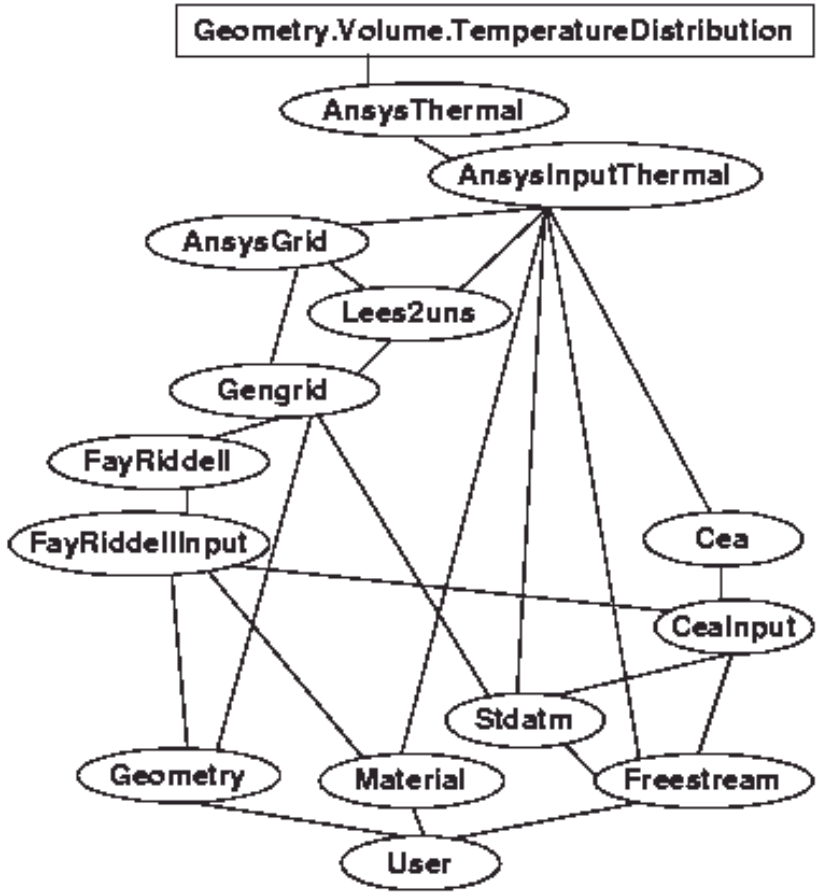
Agent-based Capabilities

- Solution Path Generator
  - Link tools together to meet user requirement
  - Tools have input/output descriptors
- Expert System based on JESS
  - Manage User Input data
  - Select proper CFD solver
  - Build CFD solver input deck

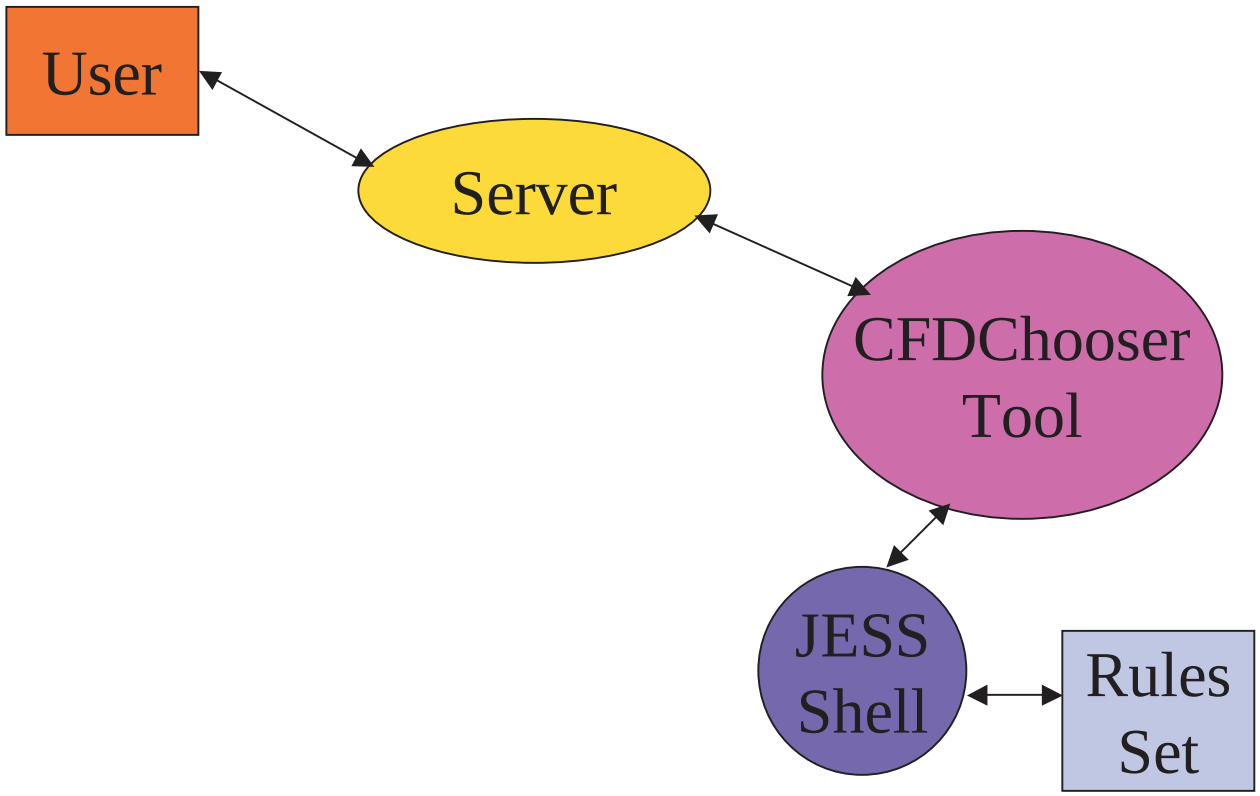
Solution Path Generation

- Each tool has a descriptors list
  - Input data
  - Output data
  - Characteristics
- Path tool matches input requirements with output from tools
- Backtrack to find links among tools

Example of Traced Path



Expert System in Framework



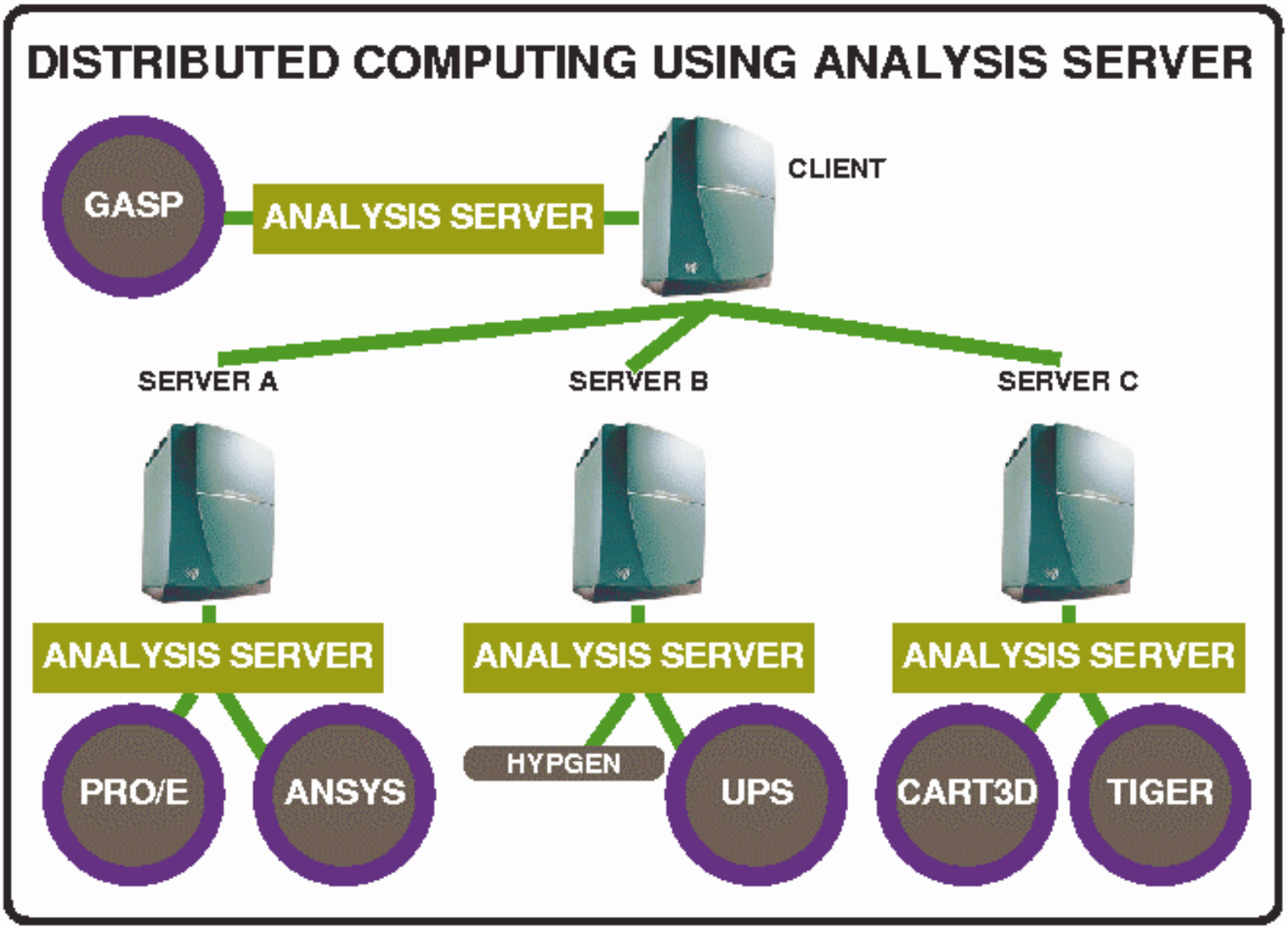
Example CLIPS Rules

```
; *****
; RULES
; *****
(defrule choose-UPS
   (cfdtool (OBJECT ?cfdtool))
   (freestream (mach ?m&:(> ?m 1.0)))
   (geometry (attachedShock TRUE))
   (geometry (wing FALSE))
   =>
   (set ?cfdtool selected "UPS")
)

(defrule choose-GASP
   (cfdtool (OBJECT ?cfdtool))
   (geometry (attachedShock FALSE))
   (geometry (wing FALSE))
   =>
   (set ?cfdtool selected "GASP")
)

(defrule choose-TIGER
   (cfdtool (OBJECT ?cfdtool))
   (freestream (viscous 0))
   =>
   (set ?cfdtool selected "TIGER")
)

(defrule print-selection
   (cfdtool (selected ?s))
   =>
   (printout t ?s crlf)
)
```

Framework Infrastructure

- Distributed Computing
  - Analysis Server
- Linking tools
  - Solution Path Generation
  - Workflow Management
- Adding/Discovering tools
  - Description Language
  - Registry

DISTRIBUTED COMPUTING USING ANALYSIS SERVER



Future Work

- Collaborate with NAS Division team
- Description Language
  - Applicable to data and tools
  - Extensible
- Tool Registry
  - Register name, location, and description
  - Allow discovery of tools

Future Work

- Improved Agents at the Tool and Path level
  - Machine learning
  - Decision making